# Diabetes Distress and Diabetes Outcomes: the Association between Distress and Patient-Provider Communication, Quality of Life, and Glycemic Control

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## Abstract

# Diabetes Distress and Diabetes Outcomes: the Association between Distress and Patient-Provider Communication, Quality of Life, and Glycemic Control

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Background: Diabetes-related distress is defined as the emotional burden associated with living with diabetes. In prior studies, elevated levels of diabetes distress, independent from depression, have been associated with worse glycemic control, as well as worse self-management and poorer medication adherence. Poor patient-provider communication has also been associated with worsened diabetes control and poorer diabetes self-care. The relationship between diabetes distress and patient-provider communication has not been examined in the primary care setting.

We hypothesized that higher diabetes distress would be associated with worse health outcomes, including glycemic control and health-related quality of life. We further postulated that diabetes distress may be associated with worse patient-provider communication.

Methods: This is a cross-sectional descriptive analysis of baseline survey data obtained in the Peer-AID study, a randomized controlled trial conducted by a partnership between the VA Puget Sound Healthcare System and Public Health Seattle King County (PHSKC), evaluating a 12-month community health worker intervention for low-income people with poorly controlled diabetes. Diabetes distress was measured using the 17-item diabetes distress scale (DDS). Health-related quality of life was assessed using the Diabetes-39 tool, the SF-12 mental health (MCS) and physical health (PCS) composite scores, as well as a single question ranking overall quality of life. The quality of patient-provider communication was assessed using a subsection of the Consumer Assessment of Healthcare Providers and Systems (CAHPS) questionnaire as well as the three Communication with Physician (CP) questions.

Results: Of 287 participants, 116 (40.4%) were categorized as no/low distress, 97 participants (33.8%) were considered moderate distress, and 74 participants (25.8%) were considered to have high diabetes distress. High-distress participants had a higher HbA1c than moderate or low distress groups (9.7% vs. 8.8% vs. 8.8%, p=0.001) and were less likely to adhere to their medications or eat a healthy diet than those in other categories. High-distress participants also reported a lower diabetes-related and overall quality of life, and had lower self-efficacy than other participants. When adjusted for age, gender, and race, a one-level increase in diabetes distress category was associated with a 0.46% higher HbA1c (95% CI, 0.19-0.74; p=0.001). Higher diabetes distress was also associated with worsened quality of life and a significant decline in patient-provider communication, as measured by both CAHPS score (-0.19, 95%CI -0.29, -0.00; p <0.001) and Communication with Physicians rating (-1.04, 95% CI -1.88, -0.21; p = 0.014).

Discussion: In this multi-site, multilingual study of low-income people with poorly-controlled diabetes, diabetes distress was found to have a significant association with HbA1c and quality of life. Our work also establishes a novel association between diabetes distress and patient perception of communication with their providers. These findings persisted after adjustment for depression, insulin use, diabetes duration, and presence of diabetes complications and demographic characteristics. This study confirms documented associations between diabetes distress and health outcomes in a low-income population and establishes a new link between diabetes distress and patient-provider communication. Further research into the nature of this association may yield new targets for interventions to improve diabetes outcomes.

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## 1. Introduction

Diabetes-related distress is defined as the emotional burden associated with living with diabetes, including that related to diabetes regimen, self-management, the threat of complications and of potential loss of functioning.[1]People with diabetes may experience negative emotions such as anger, frustration, and discouragement, and their relationships with loved ones and healthcare providers can become strained. Although some of the symptoms of diabetes distress may overlap with clinical depression, diabetes distress reflects an emotional response to a health-related condition rather than a primary affective disorder.

Nationwide, evidence suggests that glycemic control has improved in the past decades, despite an increase in diabetes prevalence, which now affects approximately 9.9% of US adults.[2] However, despite overall improved control, 1 in 5 adults with diabetes have a HbA1c level ≥8%, suggesting that even with individualized glycemic targets, glycemic control remains suboptimal for large numbers of patients. In addition, diet and physical activity guidelines are not met by the majority of U.S. diabetic patients.[3] Discovering modifiable factors that may influence diabetes control is an important public health target. In prior studies, elevated levels of diabetes distress, independent from depression, has been associated with worse glycemic control[4–6], as well as worse self-management[7] and poorer medication adherence[8]. In a recent randomized trial of education intended to reduce diabetes regimen-related distress, measured decreases in this distress were associated with improvements in medication activity, physical activity, and glycemic control.[9]

Health-related quality of life has been increasingly recognized as an important outcome; the Center for Disease Control and Prevention (CDC)'s *Healthy People 2000, 2010, and 2020* identified quality of life improvement as a central public health goal.[10] Further, self-assessed health-related quality of life has also been shown to be associated with morbidity and mortality.[11] However, the relationship between diabetes distress and health-related quality of life measures has not been established.

Effective patient-provider communication is known to be associated with improved health outcomes.[12] In diabetes, poor patient-provider communication has been associated with worsened diabetes control and poorer diabetes self-care, including medication adherence, diet, physical activity, and foot care.[7,13] A prior study by Beverly et al[14] reported an association between diabetes distress and reluctance to communicate with providers regarding self-care. Limitations of the previous study include the exclusion of those with complications, lack of income data on participants, and the use of a survey tool that had not been previously validated. Further, this study was limited to a single diabetes specialty center with a predominantly non-Hispanic white population. The relationship between distress and patient-provider communication has not to our knowledge been examined in the primary care setting, or in a low-income, racially and ethnically diverse population.

Given the interest in identifying modifiable factors associated with improved diabetes outcomes, we analyzed the association between diabetes distress and diabetes outcomes (including HbA1c and quality of life), as well as between diabetes distress and patient-provider communication, among individuals with poorly-controlled diabetes in the Peer Support for Achieving Independence in Diabetes (Peer-AID) study. We hypothesized that higher diabetes distress would be associated with worse diabetes self-management and poorer health outcomes, including glycemic control and health-related quality of life. Given previous findings that diabetes distress is associated with reluctance to discuss concerns with providers,[14] we further postulated that diabetes distress may be associated with worse patient-provider communication. See Figure 1 for the investigator's working conceptual model linking diabetes distress and these outcomes.

## 2. Methods

### Study Design and Participants

This is a cross-sectional descriptive analysis of baseline survey data obtained in the Peer-AID study. Peer-AID is an NIH-funded 5-year randomized controlled trial conducted by a partnership between the VA Puget Sound Healthcare System and Public Health Seattle King County (PHSKC) in Washington State, evaluating a 12-month community health worker in-home intervention vs. usual care for low-income people with poorly controlled diabetes. Participants (n=287) were recruited from primary care clinics at 3 sites:

Harborview Medical Center, the local public hospital; the VA Puget Sound Healthcare System; and the Sea Mar community health center, which serves a predominantly Hispanic population. Participants were English- or Spanish-speaking individuals aged 30-70; each had a diagnosis of type 2 diabetes with a recent HbA1c of ≥8.0% and an income <250% of the federal poverty level. Exclusion criteria included participation in another diabetes study, current life-threatening illness, homelessness, recent diabetes educational sessions, or inability to give informed consent.

The study methods are described in detail elsewhere.[15] All participants underwent a baseline interview at time of study entry, which included a general medical history including history of depression, a diabetes history including complications, regimen, duration, and self-care behaviors, a medication list, and physiologic data including blood pressure, HbA1c, and LDL measurement. Evaluation also included participant response to a questionnaire that assessed medication adherence, health behaviors including diet, alcohol use, and physical activity, diabetes distress, depression symptoms, health literacy, social support, self-efficacy, diabetes quality of life, and communication with healthcare providers. Racial/ethnic status was determined by self-report; participants were classified as non-Hispanic White, non-Hispanic African-American, Hispanic, or Other.

### Exposure and Outcome Measurement

Diabetes distress was measured using the 17-item diabetes distress scale (DDS; see Appendix)[16]; participants were screened using the Diabetes Distress

Screening Instrument (DDS2),[17] which asks respondents to rate on a 6-point scale the degree to which the following items caused distress: (1) feeling overwhelmed by the demands of living with diabetes, and (2) feeling that I am often failing with my diabetes regimen. An average item score on DDS2 of ≥3 prompted administration of the complete DDS. Distress categories were defined as follows: "little or no DD" (mean DDS <2.0 on DDS2 or full survey), "moderate DD" (DDS = 2.0–2.9 on DDS2 or full survey), and "high DD" (DDS ≥3.0 on full survey).[18] Diabetes distress was then coded as a single categorical variable.

Health-related quality of life was assessed using the Diabetes-39 tool[19] and the SF-12 mental health (MCS) and physical health (PCS) composite scores[20], as well as a single question ranking overall quality of life on a 1-7 Likert scale (1=lowest, 7=highest). The quality of patient-provider communication was assessed using the 4-question "How Well Doctors Communicate" subsection of the Consumer Assessment of Healthcare Providers and Systems (CAHPS) Clinician and Group Survey Core Composites questions.[21] Patient-provider communication was also assessed by the three Communication with Physician (CP) questions, which ask about participant confidence in communication with their doctor; these questions are on a 10-point scale (10 = most confident) and are reported both individually and as an average score.[22] The 3 questions are: "How confident are you that you can…ask your doctor things about your illness that concerns you?" (CP1), "…discuss openly with your doctor any personal problems that may be related to your illness?" (CP2), and "…work out differences with your doctor when they arise?" (CP3).

Diabetes self-efficacy was measured using the validated Diabetes Self-Management Efficacy Scale.[23].Responses are summed to produce a single score for self-efficacy. Possible scores range from 0–200, with higher scores indicating greater self-efficacy. Participant perception of diabetes severity was assessed by asking participants to rate the severity of their diabetes from 1-7, with 1 being not severe, and 7 being most severe.

Regarding health behaviors, diet was assessed using an eight-item validated, simplified food frequency instrument designed for use in primary care settings;[24] physical activity was assessed using the International Physical Activity Questionnaire (IPAQ), a validated and reliable measure of physical activity.[25] Medication Adherence was measured by a previously validated 8-point scale and scored as low, medium, or high adherence.[26] Current symptoms of depression were assessed using the PHQ-8.[27]

### Statistical Analysis

Data were analyzed using Stata 12.1 (STATA Corporation, College Station, TX, USA, 2006). Bivariate analyses using a chi-squared statistic for categorical variables or ANOVA test for continuous variables were used to assess associations between socio-demographic characteristics and diabetes distress category. Given the exploratory nature of this study, we did not adjust p-values for multiple testing.

Multivariable linear regression was used to evaluate the association between diabetes distress and the following: HbA1c, quality of life, CAHPS score, and Communication with Physicians score. Each of these regressions was adjusted for age, gender, and race/ethnicity. To examine if these associations are independent of depression and diabetes severity, additional regressions were run which further adjusted for depression (Model 2) and diabetes duration, insulin use, and presence of complications (Model 3.)

## 3. Results

Of 287 participants in the Peer-AID study, 143 participants averaged less than “moderate” distress on the DDS2 screen. Of these, 98 were considered no/low distress, and 45 were considered moderate distress. The remaining 135 participants completed the 17-point DDS survey. Of these, 18 participants scored an average of no/low distress, 52 participants were scored as moderate distress, and 74 were categorized as having high levels of diabetes distress. In total, 116 participants (40.4%) were categorized as no/low distress, 97 participants (33.8%) were considered moderate distress, and 74 participants (25.8%) were considered to have high diabetes distress.

Table 1 displays the population characteristics of the three distress categories. The percentage of women in the high-distress group was higher than in moderate or no/low distress groups (67.6% vs. 40.2 vs. 43.9%, respectively; p=0.001.) When compared to moderate distress and low distress groups, high-distress participants were also more likely to be depressed (81.1% vs. 53.6% vs. 36.3%, p <0.001) and reported an average of more frequent physician visits (12.3 vs. 7.5 vs. 8.8 annual visits, p=0.006.) Regarding diabetes, high-distress participants had a higher HbA1c than moderate or low distress groups (9.7% vs.

8.8% vs. 8.8%, p=0.001) and were less likely to adhere to their medications or eat a healthy diet than those in other categories. High-distress participants, on average, perceived their diabetes as more severe, reported a lower diabetes-related and overall quality of life, as well as less self-efficacy than participants in the other groups.

Although most study participants reported a positive relationship with their physicians, increased diabetes distress was associated with worse perception of patient-provider communication, both as assessed with the CAHPS and the Communication with Physician questions. This was despite the fact high-distress participants reported 17% more annual visits than moderate-distress participants and 35% more than low-distress participants.

When adjusted for age, gender, race, and depression, a one-level increase in diabetes distress category (low to medium, or medium to high) was associated with a 0.46% higher HbA1c (95% CI, 0.19-0.74; p=0.001) (Table 2). Higher diabetes distress was also associated with worsened quality of life (0.46 higher rating on 1-7 scale, 95% CI 0.37-0.54; p <0.001).

Participant perception of their communication with providers did vary significantly by diabetes distress level; a higher level of diabetes distress was associated with a decline in patient-provider communication as measured by CAHPS score (-0.19, 95%CI -0.29, -0.00; p <0.001) as well as a lower average Communication with Physicians rating (-1.04, 95% CI -1.88, -0.21; p = 0.014).

The relationships between higher diabetes distress and the outcomes of HbA1c and quality of life persisted when the regression was additionally adjusted for diabetes duration, presence of diabetes complications, and use of insulin (Model 3). When these factors were included in analysis, an increase in diabetes distress category was associated with a 0.42% increase in HbA1c (95%CI, 0.14-0.70; $p = 0.003$). A higher diabetes distress category in Model 3 was also associated with a poorer reported quality of life (0.43 higher rating on 1-7 scale, 95% CI 0.35-0.52; $p < 0.001$).

## 4. Discussion

In this multi-site, multilingual study of low-income King Country residents with poorly-controlled diabetes, diabetes distress was found to have a significant association with diabetic outcomes, including HbA1c and quality of life. This finding persisted after adjustment for depression, insulin use, diabetes duration, and presence of diabetes complications and demographic characteristics.

Our work also establishes a novel association between diabetes distress and patient perception of communication with their providers. Further, these findings persisted when controlled for age, gender, race, and ethnicity, suggesting that the association between distress and poor communication cannot be explained solely by socio-demographic and cultural factors. Determining the clinical significance of these findings will require further study. Additionally, the causality of this relationship is uncertain and cannot be obtained from this cross-sectional analysis. However, it seems plausible that poor communication could increase distress, as educational modules have been shown to lower distress. Further, at least one study[14] suggests persons with diabetes who are reluctant to discuss self-care with their doctor have higher rates of diabetes distress. As this is, to our knowledge, the first time this association has been described in the literature, further evaluation to assess the nature of this relationship is needed.

As in other studies, diabetes distress was associated with poorer diabetes self-care measures. Those with higher distress were more likely to be physically inactive and to report unhealthy eating habits. It is perhaps not unexpected that those with higher diabetes distress also report lower diabetes self-efficacy, defined as “the conviction that one can successfully execute the behavior required to produce the [goal] outcomes.”[28]

Our study has some important limitations. First, due to its cross-sectional, observational design, causality cannot be inferred for the found associations. Second, many health behaviors, such as physical activity and diet were assessed by self-report. The study’s generalizability beyond low-income persons with poorly-controlled type 2 diabetes is unknown. Further, although all participants were low-income, their precise incomes are unknown and cannot be controlled for. The effect of individual providers on both distress and health outcomes is also not addressed in this study. Despite these limitations, this study is able to provide insight into the relationship between diabetes distress and diabetes-related outcomes of glycemic control and quality of life. We confirm the documented associations between diabetes distress and less healthy behaviors in a population across multiple primary care settings, and we establish a new link between diabetes distress and patient-provider communication. Further research into the nature of this association may yield new targets for interventions to improve diabetes outcomes, such as development of didactics for providers and for patients intended to lower diabetes distress and improve communication.

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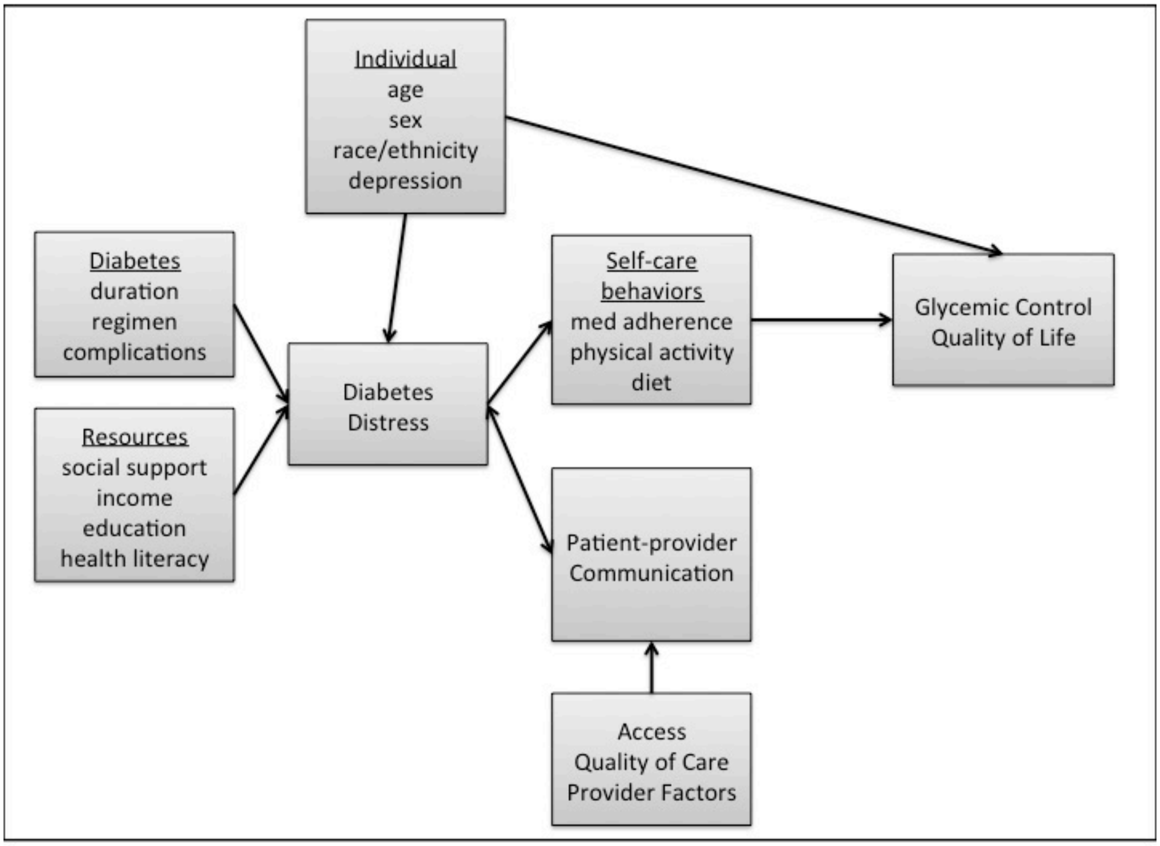

Figure 1. Conceptual Model of Diabetes Distress and Health Outcomes.

**Table 1.**
**Little/No, Moderate, and High Diabetes Distress Population Characteristics**

| | Little/No Distress n=161 (40.4%) | Moderate Distress n=97 (23.8%) | High Distress n=74 (25.8%) | p-value |
|---|---|---|---|---|
| Age (mean) | 53.3 | 52.6 | 51.1 | 0.30 |
| Female sex, % | 43.9 | 40.2 | 67.6 | 0.001 |
| Race/Ethnicity, % | | | | 0.16 |
| White | 20.7 | 23.7 | 17.6 | |
| African-American | 26.7 | 23.7 | 24.3 | |
| Hispanic | 45.7 | 43.3 | 37.8 | |
| Other | 6.9 | 9.3 | 20.3 | |
| Baseline HbA1c (mean) | 8.8 | 8.8 | 9.7 | 0.001 |
| Diabetes duration (years) | 9.7 | 10.3 | 10.9 | 0.59 |
| Insulin-dependent, % | 62.9 | 60.8 | 78.4 | 0.04 |
| Diabetes complications, % | 44.1 | 47.9 | 63.4 | 0.03 |
| MD visits/year (mean) | 8.8 | 7.5 | 12.3 | 0.006 |
| Insured, % | 54.4 | 59.0 | 57.5 | 0.79 |
| Depression, % | 36.3 | 53.6 | 81.1 | <0.001 |
| Physically inactive, % | 50.8 | 45.3 | 60.8 | 0.132 |
| Low med adherence, % | 33.3 | 49.0 | 56.8 | <0.001 |
| Self-Care: Diet Score (1-7, 7=worst) | 5.5 | 5.9 | 6.7 | 0.0008 |
| CAHPS composite score (1-4, 4=best) | 3.81 | 3.75 | 3.33 | <0.0001 |
| CP cumulative score (1-30, 30 = best) | 28.8 | 27.9 | 25.8 | 0.0007 |
| SF-12 mental component summary score (0-100, 100=best) | 51.1 | 47.0 | 39.6 | <0.0001 |
| SF-12 physical component summary score | 41.3 | 40.3 | 34.9 | 0.0007 |
| DM composite QOL score (1-7, 7 = worst) | 1.4 | 1.8 | 2.5 | <0.0001 |
| Perceived QOL (1-7, 7 = highest quality) | 5.1 | 4.5 | 4.2 | 0.0005 |
| DM self-efficacy scale (1-200, 200 = highest efficacy) | 162.8 | 145.9 | 126.8 | <0.0001 |

**Table 2. Adjusted B-coefficient and 95% CI for the association between levels of Diabetes Distress and HbA1c**

| | Model 1* | | Model 2** | | Model 3*** | |
|---|---|---|---|---|---|---|
| | B-coefficient (95% CI) | p-value | B-coefficient (95% CI) | p-value | B-coefficient (95% CI) | p-value |
| Diabetes distress | 0.38 (0.12, 0.63) | 0.004 | 0.46 (0.19, 0.74) | 0.001 | 0.42 (0.14, 0.70) | 0.003 |
| Age | -.014 (-.037 0.01) | 0.22 | -0.14 (-.037, 0.008) | 0.21 | -0.19 (-0.04,0.06) | 0.13 |
| Female Sex | 0.17 (-.23, 0.58) | 0.41 | 0.23 (-0.19, 0.64) | 0.28 | 0.25 (-0.17, 0.69) | 0.25 |
| Non-white race/ethnicity | 0.88 (0.36, 1.40) | 0.001 | 0.82 (0.28, 1.35) | 0.003 | 0.80 (0.25, 1.35) | 0.005 |
| Depression | | | -0.40 (-0.84, 0.05) | 0.075 | 0.21 (-0.25, 0.68) | 0.37 |
| Insulin use | | | | | 0.20 (-0.31, 0.70) | 0.48 |
| DM duration | | | | | 0.003 (-0.03, 0.70) | 0.82 |
| Complications | | | | | 0.21 (-0.25, 0.67) | 0.37 |

*Model adjusted for age, sex, non-white race/ethnicity
**Model additionally adjusted for depression as measured by PHQ8
***Model additionally adjusted for diabetes duration, complication, and insulin use

**Table 3. Adjusted B-coefficient and 95% CI for the association between levels of Diabetes Distress and Quality of Life**

| | Model 1* | | Model 2** | | Model 3*** | |
|---|---|---|---|---|---|---|
| | B-coefficient (95% CI) | p-value | B-coefficient (95% CI) | p-value | B-coefficient (95% CI) | p-value |
| Diabetes distress | 0.58 (0.49, 0.67) | <0.001 | 0.46 (0.37, 0.54) | <0.001 | 0.43 (0.35, 0.52) | <0.001 |
| Age | 0.008 (0.005, 0.16) | 0.037 | 0.008 (0.001, 0.015) | 0.021 | 0.005 (-0.002,0.012) | 0.22 |
| Female Sex | 0.12 (-0.02, 0.26) | 0.10 | 0.07 (-0.05, 0.20) | 0.27 | 0.04 (-0.08, 0.17) | 0.50 |
| Non-white race/ethnicity | -0.26 (-0.44, -0.08) | 0.004 | -0.12 (-0.28, 0.44) | 0.153 | -0.16 (-0.32, 0.005) | 0.06 |
| Depression | | | 0.58 (0.44, 0.71) | <0.001 | 0.55 (0.41, 0.68) | <0.001 |
| Insulin use | | | | | 0.17 (-0.13, 0.17) | 0.82 |
| DM duration | | | | | 0.008 (-0.001, 0.02) | 0.085 |
| Complications | | | | | 0.14 (-0.001, 0.17) | 0.052 |

*Model adjusted for age, sex, non-white race/ethnicity

**Model additionally adjusted for depression as measured by PHQ8

***Model additionally adjusted for diabetes duration, complication, and insulin use

**Table 4. Adjusted B-coefficient and 95% CI for the association between levels of Diabetes Distress and CAHPS (Consumer Assessment of Healthcare Providers) score.**

| | **Model 1*** | | **Model 2**** | | **Model 3***** | |
|---|---|---|---|---|---|---|
| | B-coefficient (95% CI) | p-value | B-coefficient (95% CI) | p-value | B-coefficient (95% CI) | p-value |
| Diabetes distress | -0.021 (-0.31, -0.12) | <0.001 | -0.19 (-0.29, -0.09) | <0.001 | -0.18 (-0.28, -0.07) | 0.001 |
| Age | 0.005 (-0.004, 0.13) | 0.27 | 0.005 (-0.004, 0.013) | 0.27 | 0.007 (-0.002,0.017) | 0.12 |
| Female Sex | -0.11 (-0.26, 0.04) | 0.16 | -0.10 (-0.25, 0.05) | 0.19 | -0.11 (-0.27, 0.05) | 0.18 |
| Non-white race/ethnicity | 0.05 (-0.14, 0.24) | <0.001 | 0.032 (-0.17, 0.23) | 0.75 | 0.035 (-0.17, 0.24) | 0.74 |
| Depression | | | -0.09 (-0.25, 0.07) | 0.28 | -0.06 (-0.23, 0.12) | 0.51 |
| Insulin use | | | | | -0.09 (-0.28, 0.09) | 0.33 |
| DM duration | | | | | -0.0005 (-0.011, 0.01) | 0.93 |
| Complications | | | | | -0.11 (-0.28, 0.09) | 0.22 |

*Model adjusted for age, sex, and non-white race/ethnicity
**Model additionally adjusted for depression as measured by PHQ8
***Model additionally adjusted for diabetes duration, complication, and insulin use

**Table 5. Adjusted B-coefficient and 95% CI for the association between levels of Diabetes Distress and CP (Communication with healthcare Providers) score.**

| | **Model 1*** | | **Model 2**** | | **Model 3***** | |
|---|---|---|---|---|---|---|
| | B-coefficient (95% CI) | p-value | B-coefficient (95% CI) | p-value | B-coefficient (95% CI) | p-value |
| Diabetes distress | -1.36 (-2.15, -0.58) | 0.001 | -1.04 (-1.88, -0.21) | 0.014 | -1.01 (-1.88, -0.14) | 0.024 |
| Age | 0.06 (-0.007, 0.13) | 0.081 | 0.062 (-0.008, 0.13) | 0.084 | 0.06 (-0.013,0.14) | 0.10 |
| Female Sex | -0.37 (-1.63, 0.90) | 0.57 | -0.24 (-1.51, 1.02) | 0.71 | -0.38 (-1.72, 0.95) | 0.57 |
| Non-white race/ethnicity | -0.07 (-1.66, 1.53) | 0.94 | -0.51 (-2.16, 1.14) | 0.55 | -0.75 (-2.48, 0.97) | 0.39 |
| Depression | | | -1.58 (-2.94, -0.23) | 0.022 | -1.49 (-2.91, -0.06) | 0.041 |
| Insulin use | | | | | -0.88 (-2.44, 0.68) | 0.27 |
| DM duration | | | | | 0.05 (-0.04, 0.14) | 0.28 |
| Complications | | | | | -0.46 (-1.90, 0.99) | 0.54 |

*Model adjusted for age, sex, and non-white race/ethnicity

**Model additionally adjusted for depression as measured by PHQ8

***Model additionally adjusted for diabetes duration, complication, and insulin use

## Appendix 1. Diabetes Distress Scale[16]

Each question was answered according to the following 1-6 scale:

| | | |
|---|---|---|
| ☐1. Not a problem | ☐2. A slight problem | ☐3. A moderate problem |
| ☐4. A somewhat serious problem | ☐5. A serious problem | ☐6.A very serious problem |

1. Feeling that diabetes is taking up too much of my mental and physical energy every day.
2. Feeling that my doctor doesn't know enough about diabetes and diabetes care.
3. Feeling angry, scared and/or depressed when I think about living with diabetes.
4. Feeling that my doctor doesn't give me clear enough directions on how to manage my diabetes.
5. Feeling that I am not testing my blood sugars frequently enough.
6. Feeling that I am often failing with my diabetes regimen.
7. Feeling that friends or family are not supportive enough of my self-care efforts (e.g. planning activities that conflict with my schedule, encouraging me to eat the "wrong" foods).
8. Feeling that diabetes controls my life.
9. Feeling that my doctor doesn't take my concerns seriously enough.
10. Not feeling confident in my day-to-day ability to manage diabetes.
11. Feeling that I will end up with serious long-term complications, no matter what I do.
12. Feeling that I am not sticking closely enough to a good meal plan.
13. Feeling that friends or family don't appreciate how difficult living with diabetes can be.
14. Feeling overwhelmed by the demands of living with diabetes.
15. Feeling that I don't have a doctor who I can see regularly about my diabetes.
16. Not feeling motivated to keep up my diabetes self-management.
17. Feeling that friends or family don't give me the emotional support that I would like.

Scoring: If the mean score on the first two questions was ≥3 participants were asked to complete the remaining 15 questions. The three DDS categories were defined as: "little or no DD" (mean score <2.0), "moderate DD" (mean score = 2.0– 2.9), and "high DD" (mean score ≥3.0).[18]